PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Akira BANDOH, et al

Docket No: Q81505

Appln. No.: National Stage of PCT/JP2005/008461

Confirmation No.: Unknown

Group Art Unit: Unknown

Filed: July 12, 2006

Examiner: Unknown

For: N-TYPE GROUP III NITRIDE SEMICONDUCTOR LAYERED STRUCTURE

INFORMATION DISCLOSURE STATEMENT UNDER 37 C.F.R. §§ 1.97 and 1.98

MAIL STOP AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the duty of disclosure under 37 C.F.R. § 1.56, Applicant hereby notifies the U.S. Patent and Trademark Office of the documents which are listed on the attached PTO/SB/08 A & B (modified) form and/or listed herein and which the Examiner may deem material to patentability of the claims of the above-identified application.

One copy of each of the listed documents is submitted herewith, except for the following: U.S. patents and/or U.S. patent publications; and co-pending non-provisional U.S. applications filed after June 30, 2003.

The present Information Disclosure Statement is being filed: (1) No later than three months from the application's filing date; (2) Before the mailing date of the first Office Action on the merits (whichever is later); or (3) Before the mailing date of the first Office Action after

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /S.A./

filing a request for continued examination (RCE) under §1.114, and therefore, no Statement under 37 C.F.R. § 1.97(e) or fee under 37 C.F.R. § 1.17(p) is required.

In compliance with the concise explanation requirement under 37 C.F.R. § 1.98(a)(3) for foreign language documents, Applicant encloses herewith a copy of a Communication from a foreign patent office in a counterpart application citing such documents (International Search Report for PCT/JP2005/008461 and Written Opinion of the International Searching Authority mailed August 30, 2005), together with an English-language version (if not already included) of at least that portion of the Communication indicating the degree of relevance found by the foreign patent office.

In compliance with the concise explanation requirement under 37 C.F.R. § 1.98(a)(3) for foreign language documents, Applicant further submits the following explanations:

1. Regarding the present invention

An object of the present invention is to provide a low-resistance n-type Group III nitride semiconductor layered structure having excellent flatness and few pits and to provide, from the semiconductor layered structure, a Group III nitride semiconductor light-emitting device exhibiting low forward voltage and high emission efficiency.

The inventor of the present invention found that the above object is attained by means of the pits formed in the low-resistive Ge-dopant higher concentration layer being filled up with a portion of the Ge-dopant lower concentration layer and this cycle is repeated 10 to 1000 times, and consequently accomplished the present invention.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /S.A./

Accordingly, the inventive n-type group III nitride semiconductor layered structure comprises a substrate and, stacked on the substrate, an n-type impurity concentration periodic variation layer comprising an n-type impurity atom higher concentration layer and an n-type impurity atom lower concentration layer, said n-type impurity atom being Ge, pits being provided on a surface of the higher concentration layer (a surface remote from the substrate), and said lower concentration layer being stacked on said higher concentration layer, wherein the higher concentration layer and the lower concentration layer are provided in an alternate and periodic manner and the repetition number of said higher concentration layer and said lower concentration layer is 10 to 1000, as is clear from the amended claim 1.

2. Regarding JP 11-330554 A, JP 2000-232237 A and JP 2000-286451 A (corresponding to EP 1063711 Al) listed in the International Search Report

These references arts relate to a group III nitride semiconductor light-emitting device and disclose the group III nitride semiconductor light-emitting device which has an n-side multi-film layer comprising first nitride semiconductor layer and second nitride semiconductor layer as an n-type group III nitride semiconductor laver. In these references there are descriptions that an n-type impurity is doped in either the first nitride semiconductor layer or the second nitride semiconductor layer and that the n-type impurity can be selected from elements such as Si, Ge, Sn and S, and preferably Si or Sn is used for the n-type impurity.

In these references however, there are no description and no suggestion that pits were formed in the n-type group III nitride semiconductor layer. The only n-type impurity used in examples of these prior arts is Si and in the case of Si, pits were not formed at a concentration

employed in examples. Accordingly, Ge described in these references is a mere exemplification of many n-type impurities and is not one by which a formation of pits is intended. Also, no existence of pits in the n-side multi-film layer is apparent from the fact that the n-side multi-film layer is a superlattice structure. Because the superlattice structure is a structure that does not have a defect and is regular, in case of the superlattice structure, it is a matter of course that there are no pits.

Accordingly, the present invention is different from these references in which pits are not formed, and is not obvious from these prior arts in which there is no description and no suggestion in regard to formation of pits.

3. Regarding JP 11-191639 A (corresponding to US 2003/0010993 Al) listed in the International Search Report

This reference relates to a group III nitride semiconductor light-emitting device and discloses the group III nitride semiconductor light-emitting device in which n-type contact layer comprises a nitride semiconductor doped with an n-type impurity and has a first surface and a second surface, on which a first and a second undoped nitride semiconductors are formed respectively to make a three Layer laminated structure. Also, there are described Si, Ge, Se, S and O as n-type impurities.

In this reference too, however, there is no description and no suggestion that pits were formed in the n-type group III nitride semiconductor layer. An n-type impurity used in examples of this prior art is only Si and in case of Si, pits were not formed at a concentration employed in examples. Accordingly, Ge described in this prior art is a mere exemplification of many n-type

impurities and is not one by which a formation of pit is aimed. Also, no existence of pits in the n-type contact layer is apparent from the fact that the n-type contact layer is a superlattice structure. Because the superlattice structure is a structure that does not have a defect and is regular, in case of the superlattice structure, it is a matter of course that there are no pits.

Accordingly, the present invention is different from this reference in which pits are not formed, and is not obvious from this reference in which there is no description and no suggestion in regard to a formation of pit.

4. Regarding JP 2000-82676 A (corresponding to US 6,252,255 Bl) listed in the International Search Report

This reference relates to a group III nitride semiconductor light-emitting device and discloses the group III nitride semiconductor light-emitting device in which interfaces between an active layer and first and second cladding layers are inclined from a <0001> orientation.

In this reference, however, SiH_4 is only disclosed as an n-type impurity and there are no description and no suggestion in regard to a Ge dopant and a formation of pits.

5. Regarding JP 2000-156348 A listed in the International Search Report

This reference relates to a substrate comprising a nitride semiconductor and a nitride semiconductor device using the substrate.

In this reference, there are described Si, Ge, Se and S as n-type impurities. However, it is similar to above prior arts that there is no description and no suggestion that pits were formed in the n-type group III nitride semiconductor layer, and that an n-type impurity used in examples of this prior art is only Si and in case of Si, pits were not formed at a concentration employed in

examples. Accordingly, Ge described in this prior art is a mere exemplification of many n-type impurities and is not one by which a formation of pits is intended.

6. Regarding JP 2003-17420 A listed in the International Search Report

This reference relates a gallium nitride compound semiconductor substrate which comprises growing a first gallium nitride compound semiconductor layer having a Si-doping concentration of $1x10^{19}/cm^3$ or higher, and growing a second gallium nitride compound semiconductor layer, which is undoped or has a Si-doping concentration of $1x10^{19}/cm^3$ or lower, on the first gallium nitride compound semiconductor layer. Also, there is a description that O, Ge, Sn and S may be used as a dopant other than Si.

However, this reference relates a gallium nitride compound semiconductor substrate on which a semiconductor device structure is formed, and on the other hand, the present invention relates a semiconductor device structure (an n-type group III nitride semiconductor layered structure) itself formed on a substrate of sapphire, etc. Accordingly, both inventions are essentially different from each other. In this prior art, also, there is no description and no suggestion that the repetition number of the first layer and the second layer is 10 or more.

7. Regarding JP 2003-12398 A listed in the International Search Report

This reference relates a growth method of group III nitride semiconductor layer and discloses that a first group III nitride semiconductor layer is formed at higher pressure and then a second group III nitride semiconductor layer is formed at lower pressure on the first layer.

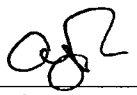
In this reference, however, there are no description and no suggestion in regard to an n-type impurity and a pit formed by the n-type impurity. Of course, there is no description and no

suggestion that a lower concentration layer of Ge-dopant is stacked on a higher concentration layer of Ge-dopant.

The submission of the listed documents is not intended as an admission that any such document constitutes prior art against the claims of the present application. Applicant does not waive any right to take any action that would be appropriate to antedate or otherwise remove any listed document as a competent reference against the claims of the present application.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



Abraham J. Rosner
Registration No. 33,276

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

WASHINGTON OFFICE
23373
CUSTOMER NUMBER

Date: July 12, 2006

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /S.A./

MODIFIED PTO/SB/08 A & B (08-03)

Substitute for Form 1449 A & B/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet	1	of	1

Complete if Known	
Application Number	National Stage of PCT/JP2005/008461
Confirmation Number	Unknown
Filing Date	July 12, 2006
First Named Inventor	Akira BANDOH
Art Unit	Unknown
Examiner Name	
Attorney Docket Number	Q81505

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number: Number	Document Number: Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document
		US 2003/0010993	A1	01/16/2003	SHUJI NAKAMURA, ET AL
		US 6,252,255	B1	06/26/2001	YOSHIHIRO UETA, ET AL
		US			
		US			
		US			
		US			
		US			
		US			
		US			

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document: Country Code[3]	Foreign Patent Document: Number[4]	Foreign Patent Document: Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Translation[6]
		JP	11-330554	A	11/30/1999	NICHIA CHEM. IND. LTD.	Abstract
		JP	11-191639	A	07/13/1999	NICHIA CHEM. IND. LTD.	Abstract
		JP	2000-232237	A	08/22/2000	NICHIA CHEM. IND. LTD.	Abstract
		JP	2000-286451	A	10/13/2000	NICHIA CHEM. IND. LTD.	Abstract
		JP	2000-82676	A	03/21/2000	SHARP CORP.	Abstract
		JP	2000-156348	A	06/06/2000	NICHIA CHEM. IND. LTD.	Abstract
		JP	2003-17420	A	01/17/2003	NICHIA CHEM. IND. LTD.	Abstract
		JP	2003-12398	A	01/15/2003	SAMSUNG ELECTRO MECH. CO. LTD.	Abstract
		EP	1 063 711	A1	12/27/2000	NICHIA CHEMICAL INDUSTRIES, LTD.	

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city, and/or country where published.	Translation[6]

Examiner Signature	/Selim Ahmed/	Date Considered	05/06/2009

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1]Applicant's unique citation designation number (optional). [2]See Kind Codes of USPTO Patent Documents at www.uspto.gov, MPEP 901.04 or follow the hyperlink from the title of the document to the intranet. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST. 3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to indicate here if English language Translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /S.A./